

CLAIMS

The embodiment of the invention in which an exclusive property or privilege is claimed is defined as follows:

1 1. A process for rapidly heating a fuel processor to its operating
2 temperature, the process comprising:

3 a) reforming fuel with a catalyst to produce steam, carbon monoxide, and hydrogen
4 gas;

5 b) homogeneously mixing air with the carbon monoxide and hydrogen gas to create
6 a mixture which will react and produce heat;

7 c) using the heat to raise the temperature of catalysts in the fuel processor;

8 d) combining the mixture with an oxidant to decrease the concentration of carbon
9 monoxide;

10 e) using the heat to produce steam; and

11 f) mixing the steam with the mixture to increase the yield of hydrogen gas.

1 2. The process as recited in claim 1 wherein a front edge of the reforming
2 catalyst is heated to a temperature at which a fuel-air mixture ignites and generates
3 heat which can be used for vaporization of subsequent fuel.

1 3. The process as recited in claim 1 wherein the catalyst causes catalytic
2 partial oxidation (CPOX).

1 4. The process as recited in claim 3 wherein the partial oxidation is of
2 hydrocarbons with oxygen (O₂) to produce carbon monoxide (CO), hydrogen (H₂),
3 carbon dioxide (CO₂), and water (H₂O).

1 5. The process as recited in claim 1 wherein the mixture is subjected to
2 catalyst at a temperature of from about 25°C to 500°C.

1 6. The process as recited in claim 1 wherein the oxidizing agent facilitates
2 the oxidation of hydrogen and carbon monoxide.

1 7. The process as recited in claim 1 wherein the air-carbon monoxide-
2 hydrogen gas mixture contains an oxygen/carbon ratio of more than one and less than
3 2.

1 8. The process as recited in claim 1 wherein the fuel can be liquid, vapor, or
2 a combination thereof.

1 9. The process as recited in claim 5 wherein the temperature is reached
2 within 30 seconds.

1 10. The process as recited in claim 1 wherein the air-to-fuel and steam-to-fuel
2 ratios are adjusted to have temperatures in the reforming fuel catalyst from between
3 about 600°C to 850°C.

1 11. The process as recited in claim 1 wherein the maximum temperature in
2 the reforming fuel catalyst is about 900°C.

1 12. A method for converting hydrocarbon fuels to a reformat gas, the
2 method comprising:

- 3 a) producing combustible moieties from the fuels;
4 b) oxidizing the combustible moieties to generate heat;
5 c) utilizing the heat to increase the surface temperatures of catalysts; and
6 d) contacting the reactants to the catalysts.

1 13. The method as recited in claim 12 wherein the step of producing
2 combustible moieties further comprises combining the fuel with an oxidant to create a
3 mixture.

1 14. The method as recited in claim 13 wherein the oxygen/carbon ratio of the
2 mixture is more than one and less than 2.

1 15. The method as recited in claim 12 wherein the combustible moieties are
2 carbon monoxide and hydrogen.

1 16. The method as recited in claim 12 wherein the step of contacting the fuel
2 to the catalyst results in the formation of carbon monoxide and hydrogen gas.

1 17. The method as recited in claim 15 wherein a portion of the carbon
2 monoxide and hydrogen is reacted with oxygen to create heat.

1 18. The method as recited in claim 17 wherein the heat raises the
2 temperature of a water-gas shift catalyst so the catalyst becomes active for its water-
3 gas shift reaction which converts carbon monoxide and generates additional heat.

1 19. The method as recited in claim 12 wherein air is injected downstream of
2 the catalysts to have complete oxidation of all combustible moieties before
3 the combustible moieties have egress from the system.

1 20. The method as recited in claim 12 wherein liquid water is injected when
2 the water-gas shift catalyst temperature exceeds 400°C.

1 21. The method as recited in claim 19 wherein the liquid water is injected in
2 the form of water droplets having diameters less than 50 microns (μ).

1 22. A device for the vaporization of fuel, the device comprising:
2 a) a means to provide the latent heat of vaporization of the fuel; and
3 b) a means to provide superheating of the fuel.

1 23. The device as recited in claim 22 wherein the means to provide the
2 latent heat of vaporization of the fuel is a first heating element.

1 24. The device as recited in claim 22 wherein the means to provide
2 superheating of the fuel is a second heating element.